

January 21, 2009

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<p>CC: GSFC/G. Colon LaRC/E. Grigsby</p>	<p>ESM Program Office Director ESSP Program Office Director</p>

From: NASA HQ/DK/ M. Freilich/ Director, Earth Science Division

Subject: Call for Proposals – Senior Review 2009 and the Mission Extension for the Earth Science operating missions

The NASA Earth Science Division (ESD) of the Science Mission Directorate (SMD) is supporting 13 Earth observing missions that are, or soon will be, operating beyond their prime mission lifetimes. Each of these missions has made unique contributions to NASA research objectives, and in many cases mission extensions have great potential for advancing the ESD science goals. Additionally, data from several of these *research* missions are being used routinely by other U.S. agencies in support of national goals for Earth system prediction and monitoring. Extended operations and associated data production activities require a significant fraction of the ESD annual budget. NASA and the ESD thus periodically evaluate the allocation of mission operation and data analysis funds with the aim of maximizing the missions' contributions to NASA's and the nation's goals. This periodic NASA evaluation process for missions in extended operations is known as the "Senior Review."

ESD will host the next Senior Review during the weeks of April 27 and May 11, 2009. This letter describes the objectives and process for the review, contains instructions for the preparation and submission of proposals, and provides initial guidelines for in-person presentations to the Science review panel.

The 2009 ESD Senior Review will assess the merit and performance of these thirteen missions (in alphabetical order): ACRIMSAT, Aqua, Aura, CALIPSO, CloudSat, EO-1, GRACE, ICESat, Jason-1, QuikSCAT, SORCE, Terra and TRMM. Performance factors are to include scientific productivity, contribution to national objectives, technical status and budget efficiency.

The Senior Review:

The objectives of the ESD Senior Review are to (1) identify those missions beyond their prime mission lifetime whose continued operation contributes cost-effectively to both NASA's goals and the nation's operational needs (expected to be the overwhelming majority of on-orbit missions); and (2) identify appropriate funding levels for those missions determined worthy for extension. While a mission's identified potential contribution to NASA's research science objectives is the primary evaluation criterion for mission extension, the ESD 2009 Senior Review explicitly acknowledges (1) the importance of long term data sets and overall data continuity for Earth science research; and (2) the direct contributions of mission data to

national operational objectives, particularly the routine use of near-real-time products from NASA **research** missions to advance the objectives of **operational** agencies such as NOAA, DoD, and USGS.

The Senior Review process described in detail below involves submission of a mission extension proposal by each mission team, evaluation of the proposals by independent panels composed of members of the scientific community and federal agencies, and provision of the panels' written findings to the ESD Director as input to the ESD and SMD final decisions for mission extensions.

Each of the thirteen missions listed above will submit a proposal outlining how their science investigations over the period for the review (FY10-FY13) will benefit the Earth Science research objectives and focus areas described in the Science Plan for NASA's Science Mission Directorate 2007-2016 (the *SMD Science Plan*). Each proposal will contain

- a) descriptions of the project's proposed science investigations and data products;
- b) a summary of the project's recent accomplishments;
- c) the mission's technical status relating to the ability of the project to conduct the proposed science investigation and deliver data products;
- d) the contribution of the mission and its data products to national objectives for Earth system monitoring, prediction, and response; and
- e) a high level budget for the proposed activities.

Specific instructions for proposal content and format are provided below. *Note that Education and Public Outreach activities will be proposed and reviewed separately following the Senior Review decisions.*

Two Senior Review panels (a Science Panel and a Core Mission Review Panel, described in more detail below) will be constituted by ESD to evaluate these proposals in April-May 2009. Their evaluations will be documented in reports to ESD. ESD will use the panels' findings, rankings and conclusions as inputs to produce the two primary products of the Senior Review, to be provided to the ESD Director:

- 1) A recommendation for the extension or termination of each mission, based primarily (but not exclusively) on the mission's technical status and evaluation of the mission's potential future contributions to NASA and national goals; and
- 2) A recommended *minimum* NASA funding allocation for each mission for the period 2010-2013. For missions that will be continued, this *minimum* NASA funding covers mission operations and continued production of high quality core data products (defined in the "Extended Mission Scope" section below). If a mission is recommended for termination, this funding covers termination and spacecraft disposal costs, if any.

The Senior Review Panels:

The Senior Review Science Panel will be the primary independent analysis group, with sole responsibility to evaluate the scientific merit of the NASA mission based on the applicability of the mission's science to NASA Earth science strategic plans and objectives.

In addition, ESD will constitute a Core Mission Review Panel (CoMRP) to assess the health and viability of the operating satellites, the proposed mission operations and data analysis costs and approaches, and the utility and applicability of the mission's data products to satisfy national operational objectives of non-NASA agencies. The CoMRP will consist of 2 subpanels: the National Needs Subpanel, drawn primarily from other federal agencies and users of NASA research data for applied and operational purposes; and the Technical & Cost Subpanel, drawn from technical experts in and outside NASA. The CoMRP's findings will be briefed to the Senior Review Science Panel, and used by the Science Panel to develop its findings.

Extended Mission Scope:

Proposals should focus on describing and justifying the minimum resources and activities required to continue the **basic mission** – that is, the minimum resources and activities required to conduct mission and science operations and to continue routine production and delivery of *core mission data products*. The *core data products* are those developed, refined, and validated during the prime mission (and any previous mission extensions) that have reached a level of maturity that requires algorithm maintenance only. Routine, continued calibration and validation activities for algorithm and product quality maintenance may be included during the extended mission. Compared to the prime mission phase, fewer services should be

offered to external data product users during the extended mission, as users are assumed to have become more knowledgeable during the mission's prime and previous extension phases. The basic mission should include the minimum necessary science review and assessment of instrument performance to verify and validate the data products. The proposal should clearly justify the level of science support required to maintain the quality of these core data products.

Compared to the prime mission phase, proposers are encouraged to propose and justify an increased risk of data collection degradation in exchange for an associated reduction in mission cost. Mission operations coverage should provide for the safe management of the aging satellite, but greater allowance for hands-off operation should also be considered. As the basic mission operations and data delivery focus on the continued execution of proven processes, it is expected that a continuous improvement process will result in reductions in the cost of these established activities during the extended mission.

Enhanced or extended data products and science are not solicited in this year's Senior Review. The ESD Research Program sponsors several competitive solicitations that support theory, data analysis and investigations into merged or enhanced products. These solicitations provide an alternative source of support for enhanced or expanded science research using mission data.

Funding Environment:

Missions proposing to the ESD Senior Review will compete for an allocation from a pool of funds comprised primarily of the budgets from all of the missions in extended phase for each fiscal year under consideration.

Each mission must propose and justify an "in-guide" budget which does not exceed the current NASA operating plan (the "N2" budget) for each year in the period under review. The in-guide budget profile will be provided to each mission team prior to proposal preparation and submission.

Missions may optionally propose and justify an "optimal" budget (and associated activities scenario) that could potentially result in benefits such as more efficient future operations, improved data continuity/quality, and/or increased utilization by the research community; however, because the pool of funds available to the extended missions is highly constrained, typically few optimal proposals are accepted.

Other sources of funds, primarily through the Research Opportunities in Space and Earth Science (ROSES), are available and are currently being used to support activities related to many of the ESD missions. While the Senior Review proposals must identify any ROSES (or other) complementary funding being used to support production of core data products, the Senior Review decisions will not influence the funding levels or objectives of previously selected ROSES investigations.

HQ may decide to continue the basic mission, or terminate mission operations. As always, the budgets ultimately allocated to the individual missions are contingent upon the availability of the funds to the SMD and the ESD. Should the arrival of a new Administration significantly change the funding environment, the mission teams will be informed as soon as possible.

Instructions to Proposers:

Each mission that is subject to this Senior Review and that is seeking to continue operation shall submit a proposal outlining their mission implementation approach and proposed Project-supported science investigations for the FY2010 – FY2013 period covered by the review.¹ The proposals must detail and justify how the project will continue to conduct basic mission operations and to provide core data products that meet ESD Research, NASA, and national needs.

The written proposal shall contain a science section, a technical/budget section, and four required appendices containing a mission data product inventory, budget spreadsheets, references and a list of acronyms. Note that there is NO Education/Public Outreach (E/PO) section; the E/PO proposals are to be submitted separately from the mission proposals after the conclusion of the Senior Review, anticipated in summer 2009.

For all missions except Terra, Aqua, and Aura, the scientific and technical/budget sections should be no more than 30 pages. For Aqua and Aura, the same sections should be no more than 41 pages, and Terra should be no more than 45 pages. For all missions, the technical/budget section should be approximately one-third of the entire proposal. All pages are to be on 8.5 inch by 11 inch paper, with character (font) size not less than

¹ If a mission team believes that their satellite should not be provided with extended funding, the mission Project Scientist or Principal Investigator should justify this decision in a letter to the ESD Director, Dr. Michael Freilich, prior to the due date for the mission extension proposal.

10 points. Not included in the page limits are the four required Appendices and a fifth optional Appendix containing technical performance data. The proposal must be submitted in PDF format with the budget spreadsheets in XLS format (see below). (If your institution requires signatures, please place them on one separate submittal letter; copies of this submittal letter will not be used in the peer review but will be retained within the ESD. The project name and names of key authors at the top of the first page will suffice for review purposes.)

Instructions for the Science Section: The science section should comprise approximately two-thirds of the proposal. In this section, describe the science merits of your program and the specific contributions of the instruments within your mission. The science proposal should list the current science objectives for the mission and a summary clearly focused on what has been accomplished in the past two years. The science section should explain how the proposed science program contributes to the ESD research objectives and focus areas as stated in the SMD Science Plan.

The core mission data product discussion should describe how the mission will continue to produce the core data products during the extension, including discussion of any current or predicted instrument or spacecraft performance degradations that affect the quality of those products. The core data products include those valuable higher level (typically but not restricted to level 1 and level 2) data products that are produced on a routine basis and that are typically tied to the mission level 1 requirements. If products have developed since launch and are now considered core, they should have clear and mature algorithms supporting their production, and should show a clear traceability to NASA science or national operational objectives. Resources required for routine calibration, validation, and algorithm maintenance to maintain the quality of these core data products should be included. A list of core data products, highlighting products which have been added since the last Senior Review (or since launch for Aura and CALIPSO), should be included in Appendix A.

For core data products that rely on data from missions or instruments outside of the proposing project's control, identify the required external resource. If all NASA parties in the shared data product are proposing in response to this letter, each mission should detail its own elements of the task along with the complementary support from the other mission(s).

Identify any parallel funding sources, such as ROSES, that are **required** for supporting any of the activities in these mission extension proposals, both for efforts already funded and for anticipated future funding. Indicate if the funding is already approved through an existing grant, or is anticipated support based on a future award for an existing or expected research announcement.

A brief summary of the programmatic elements required for mission implementation should be provided, including the geographic and organizational locations of key mission elements (science management, project management, ground station, science data acquisition and distribution center, etc.), and the identification and roles of any international or inter-Agency partners.

Projects should consider providing an on-line bibliography of recent publications. The proposal should contain the URL/web address to this bibliography. Bibliographies included in the text of the proposal will be counted against the page limit.

Instructions for the Technical/Budget Section: This section should be approximately one-third of the proposal and should have three major sub-sections. Begin with a discussion of the overall technical status of the components of the mission. These should include the spacecraft, instruments, and ground systems including spacecraft control center and science center(s). The discussion should summarize the health of the components and point out limitations as a result of degradation, aging, use of consumables, obsolescence, failures, etc. Proposers are encouraged to provide supporting data in the form of engineering data tables and figures in the optional Appendix E. Include an estimate and rationale of mission life expectancy. Provide a high-level description of the approach for end of life activities in compliance with NASA requirements (i.e., satellite passivation, disposal in place, controlled re-entry, etc.)

The second part of the section should discuss the proposed budgets. ***The budgets proposed in the Senior Review must be fully consistent with the budgets submitted in the parallel Program Planning & Budget Execution (PPBE) 2011 process.*** Labor, major equipment and other expenses for both the in-guideline scenario and the optimal scenario must be explained in sufficient detail to determine the incremental cost of each proposed task. The budget must include any project-specific costs including mission services

performed by the ESMO at GSFC, at JPL, by NASA's networks such as the Ground Network (GN), the Space Network (SN), or the NASA Integrated Network Services (NISN).

Summarize anticipated 'in kind' support from NASA-funded sources other than the project's MO&DA budget. These 'in kind' sources include but are not limited to: processing of mission data to generate core data products; satellite tracking support from NASA networks; and support from the multi-mission infrastructure projects at GSFC, JPL, and elsewhere. Supporting or in-kind sources that should NOT be included: parallel algorithm development activities funded through ROSES; supporting activities from non-NASA sources such as international partners, other US Government agencies. However, the extent of the partners' participation and their funded technical and programmatic contributions should be identified in the narrative.

Attachment A to this letter contains the Work Breakdown Structure and definitions for "MO" and "DA." Attachment B contains instructions and the mandatory form for the budget portion of each proposal. This form will serve as the standard budget spreadsheet for all proposals. Each proposal should contain narrative and further details in a format as determined by each project. For the period under consideration in this Senior Review, FY10-FY13, two scenarios should be summarized in the mandatory form and described in the technical/budget proposal: an "In-Guideline" Scenario and a "Requested/Optimal" Scenario.

- **In-Guideline Scenario:** Describe a plan which does not exceed the guideline of the current NASA operating plan (the "N2 budget") in each year. The in-guideline scenario is assumed to be sufficient to achieve the basic mission science objectives, including its contribution to national goals. All efforts must be made to develop a detailed and justified in-guide budget. If the project believes the current budget guideline is insufficient to support the present set of products and activities, the project should identify the set of activities and products that will be supported, and the impacts of any adjustments in work content on the science return for the mission.
- **Optimal Scenario:** You may describe a funding level that leads to a more effective or efficient mission or improves data continuity/quality, but still recognizes the very tight fiscal constraints that NASA faces. In other words, the optimal scenario should be a carefully considered request, not a maximal request. The technical/science description of this scenario should clearly define the discrete items or activities mapped to the WBS (see Attachment A) and expected benefits compared to the in-guideline scenario. The required budget should include credible cost estimates and bases of estimates phased by year.

The budget spreadsheet provides tables for 'in-kind' support and for instrument team budgets. The format for the tables of in-guideline, optimal, and in-kind budgets all follow the WBS breakdown described in Attachment A.

The third part of the section should propose one or more efficiency metrics. Because an efficiency metric has not been requested previously, some background is provided here with more information in Attachment C. The Office of Management and Budget (OMB) has requested that all SMD Divisions report performance on efficiency metrics for missions in extended operations. Efficiency metrics are quantifiable measures of productivity and must be reducible to some form of decreasing unit cost for products or activities. The metrics proposed will be reported as part of an umbrella ESD metric to OMB, and will be a factor in the performance ratings NASA receives from OMB. Therefore, ESD is seeking your assistance in identifying metrics that are both meaningful and readily implemented. The request is being made through the medium of the Senior Review since efficiency metrics are best developed as part of the work and budget planning process, rather than imposed afterwards.

Each mission must propose one or more efficiency metrics, choosing either from the list of pre-approved metrics specified in Attachment C, or defining a more appropriate alternate(s). If the alternate metric is accepted by OMB, only the alternate will be used for reporting. The metrics must be quantifiable measures of a project's efficiency (see Attachment C for definitions and for OMB's view of the difference between 'efficiency' and 'effectiveness'.) The efficiency metric discussion should include the FY09 baseline, annual targets for the years FY10-FY13, and a brief explanation of management actions, such as continuous improvement plans, that will be taken to achieve the metric(s).

Because this is the first time efficiency metrics have been requested, the CoMRP will be asked to comment on the proposed metric, but the metrics evaluation will NOT be a factor in the final 2009 Senior Review decisions.

Instructions for the E/PO Section: As previously noted, the E/PO proposals will be submitted separately from the mission proposals after the conclusion of the Senior Review, anticipated in the summer of 2009. In the Senior Review proposal which is submitted in response to this letter, do not include any narrative for E/PO activities, and show only your intended E/PO budget as a WBS line item in the budget spreadsheets. You should plan to use approximately 1-2% of your total budget for E/PO activities.

Required Appendices: Four appendices are required and do not count against the page limit:

Appendix A: Mission Data Product Inventory. Include a brief (no more than 100 words per product) summary description of the data product; the approximate time duration of the data record; the instrument(s) required to produce the product; the maturity of the algorithm(s) required to produce the product; the primary NASA and/or operational Agency users (including contact information such as phone or e-mail addresses to assist the CoMRP review); and the availability and location of the product for community use and access.

Appendix B: Mission budget in specified format. Attachment B describes the mandatory format for your budget request and supplies a spreadsheet template. Supplementary, detailed cost information to assist the cost evaluation is encouraged, and does not count against the page limit.

Appendix C: Acronym list

Appendix D: References actually cited in the text of the proposal.

Appendix E: Engineering trend data to support the spacecraft and/or instrument projected performance and life expectancy. This appendix is optional and does not count against the page limit.

Proposal Submission:

Proposals must be uploaded electronically in PDF format to a NASA HQ Scienceworks website (<https://scienceworks.hq.nasa.gov/>) and must be received by 6:00 PM EST on Tuesday, March 23, 2009. Simultaneously, each project must upload their budget spreadsheets and supplemental cost data in XLS format. The budget spreadsheets should not be incorporated into the proposal document but should be uploaded as separate files.

The meeting of the Senior Review Panel meeting:

The CoMRP will meet two weeks before the Senior Review Science Panel to permit their findings to be available to the Senior Review Science Panel. The National Needs subpanel will meet for 2 days, at the same time as the Technical and Cost subpanel.

The Senior Review Science panel will meet twice, once to discuss the proposals and develop questions for the missions to answer during the presentations, and again to meet with the projects, discuss their evaluations and develop findings.

1st Meeting:

- Morning: Instructions, Operating Missions background, logistics (writing assignments, etc.), discussion of conflicts of interest and procedures to minimize their impacts.
- Afternoon: Discussion of Proposals & Develop Questions for the Projects.

2nd Meeting:

Day 1:

- Morning: Review Instructions, Operating Missions background, logistics (writing assignments, etc.) and briefings from the CoMRP subpanels.
- Afternoon: Project Presentations.

Day 2: Complete Project presentations.

Day 3: The Senior Review panel completes instructed tasks (1) through (5).

Instructions to the Senior Review Panels/Review Criteria:

NASA HQ will provide the following instructions to the Core Mission Review Panel:

The National Needs SubPanel will be asked to evaluate the contributions of the core data products to national operational objectives by assigning a High/Medium/Low utility value to each product or group of products.

The Technical and Cost Subpanel will be asked to assess the proposal's performance and reliability projections for the satellite and instrument(s), the mission operations implementation plan, the planned generation and delivery of the core data products, and the likelihood of accomplishment within the proposed cost. The evaluation will consider factors including the status of consumables and predicted utilization; spacecraft and instrument status, performance degradation, and failure risk; mission operations approach for the effective and safe management of an aging satellite; and mission and data management. Strategies to preserve the health of the hardware, to mitigate performance degradation and failures, to manage on-orbit consumables, and to ensure the continued performance and reliability of the ground systems will be assessed. The adequacy and robustness of the cost plan will also be a factor in this evaluation. The evaluation will result in narrative text as well as a risk rating for the feasibility of the extended mission implementation.

NASA HQ will provide the following instructions to the Senior Review Science Panel:

- (1) In the context of the ESD science goals, objectives and research focus areas described in the NASA Science Strategic Plan, evaluate and rank the scientific merits of the proposed returns from each mission during FY2010 and FY2011. Include consideration of the value of and need for continuation of high value, high quality long term data records and overall data continuity.
- (2) Review the overall data products inventory for all missions under review, identifying possibly redundant or complementary products not noted by the individual mission proposals, and search for synergies not realized.
- (3) Assess the cost efficiency, data collection, and operational effectiveness as secondary evaluation criteria, after science merit of the proposed research and data product development and delivery.
- (4) Drawing on (1) - (3), provide science-based findings for the ESD extended missions for FY2010 and FY2011, including specifically:
 - Continuation of projects "as currently baselined";
 - Continuation of projects with either augmentations or reductions to the current baseline;
 - Validation of, or recommended changes to, the proposed definition of core data products for each mission;
 - Directed additional collaborations between missions where synergies may exist;
- (5) Provide preliminary assessments and findings equivalent to (1) through (4) for FY2012 and FY2013.

Presentations to the Senior Review panel:

Approximately 12 hours will be available for the mission presentations to the Senior Review Science panel during the panel's second meeting. Each proposing project will be allotted time for an oral presentation to the panel, with the time allocation varying depending on the mission size and complexity, with a minimum duration of 30 minutes allotted for any single mission. Two weeks before the presentation, each mission team will be provided a set of questions from the Science Panel and a time allocation. To minimize the burden on projects, no more than three people may represent any one of the missions, or one representative per major instrument on the mission, whichever is greater. During each project presentation, the project representatives should plan on using no more than one-half of the allocated time for their prepared presentation, reserving one-half for additional questions and answers. The prepared presentation should concisely and thoroughly answer the specific questions that the Science Panel provided to the mission team following their initial review.

- The primary purpose of the oral presentations is to provide a forum for questions from panelists and answers from the projects.
- Secondly, this is an opportunity for projects to provide any significant updates, e.g. science results obtained since proposal submission.
- Lastly, and with lowest priority, it is an opportunity to repeat highlights of the proposals, which will have been read by all panelists.

After the meeting of the Senior Review panel:

The Senior Review panel will provide a mature draft of key findings and conclusions and will brief the ESD Director, prior to completing its deliberations. Within six weeks following the ESD review, the panel will submit its final written report to the ESD Director and the report will later be posted to a public NASA HQ web site.²

NASA HQ will contact each of the proposing missions/projects and relay the new SMD mission extension decisions resulting from the Senior Review. The decisions will include new budget guidance, if appropriate, programmatic guidance including possibly notices of intent to terminate, and other specific instructions resulting from the Senior Review process. Within four weeks of being informed of the Senior Review decisions, each project must submit back to HQ its plan for complying with the new guidance and instructions.

Throughout the Senior Review process the HQ program scientists and executives will ensure that key officials in participating international space agencies or other U.S. government agencies that are partners in a proposing mission are kept informed. The HQ program officers will be responsible for apprising our partners of NASA's decisions resulting from the Senior Review.

Schedule for the 2009 Senior Review:

The following is a schedule for the 2009 Senior Review and for the mission extension and planning process for the Earth Science operating missions:

Mission Team Feedback at AGU:	December 17, 2008
Call for Proposals issued:	January 21, 2009
Proposals due:	March 23, 2009
CoMRP (2 subpanels) review	April 27-29, 2009
Senior Review panel meets:	May 12-14, 2009
Publication of the panel's report	June 2009
New budget guidelines and instructions to projects:	July 2009
Projects revised implementation plans to ESD	August 2009

Further Information

A resource library website will be established at http://2009ESD_SeniorReview.larc.nasa.gov. Proposers may have requests for clarification on any of the items contained in this letter or on the website. For further information, contact the Senior Review Program Officer, Cheryl Yuhas, at Cheryl.L.Yuhas@nasa.gov, or at the address below. The ESD will review all requests for information and if additional updates are sent out they will be shared with all proposers. It is the sole discretion of the ESD to determine which, if any, clarifications are required.

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Three attachments:

- A. Definitions of the Work Breakdown Structure for NASA Science Operating Flight Missions
- B. MS Excel spreadsheet: ESD Senior Review FY10-FY13_Std_Spreadsheet.xls
- C. Efficiency Measures

² See for example: http://nasascience.nasa.gov/earth-science/mission_list. Reports from the 2007 Senior Review are currently available on this site.

Attachment A: Definitions of Work Breakdown Structure for NASA Science Operating Missions

The WBS elements shown below are intended for flight projects in all phases of implementation, from pre-Phase A through mission termination and disposal. The Projects should use the WBS dictionary for guidance on how to break out their proposed costs, but as general suggestion for missions in operation, and in particular in extended operations beyond the primary mission phase, only a subset of the standard WBS elements are expected to show any activity. Among the eleven level 2 WBS categories identified below, active elements for our missions would reasonably be:

- 1.0 Project Management
- 4.0 Science/Data Analysis
- 7.0 Mission operations
- 9.0 Ground systems
- 11.0 Education & Public Outreach

Management of the mission elements could be accounted for in either Project Management (1.0) or Science (4.0), with the projects defining the appropriate distribution in their proposals. Any efforts related to Systems Engineering (2.0), Safety and Mission Assurance (3.0), Payload (5.0) and Spacecraft (6.0) could reasonably be folded into Mission Operations (7.0) for extended missions. Launch vehicles (8.0) and Systems Integration and Testing (10.0) clearly are no longer applicable.

(Taken from the draft NASA Procedural Requirements, NPR 7120.5D, Appendix G)

Standard Level 2 WBS elements for space flight projects are shown in Figure G.4-1. The standard WBS template below assumes a typical spacecraft flight development project with relatively minor ground or mission operations elements. For major launch or mission operations ground development activities which are viewed as projects unto themselves, the WBS may be modified. For example, the spacecraft element may be changed to reflect the ground project major deliverable product (such as a facility). The elements such as payload, launch vehicle/services, ground systems, mission operations system that are not applicable may be deleted.

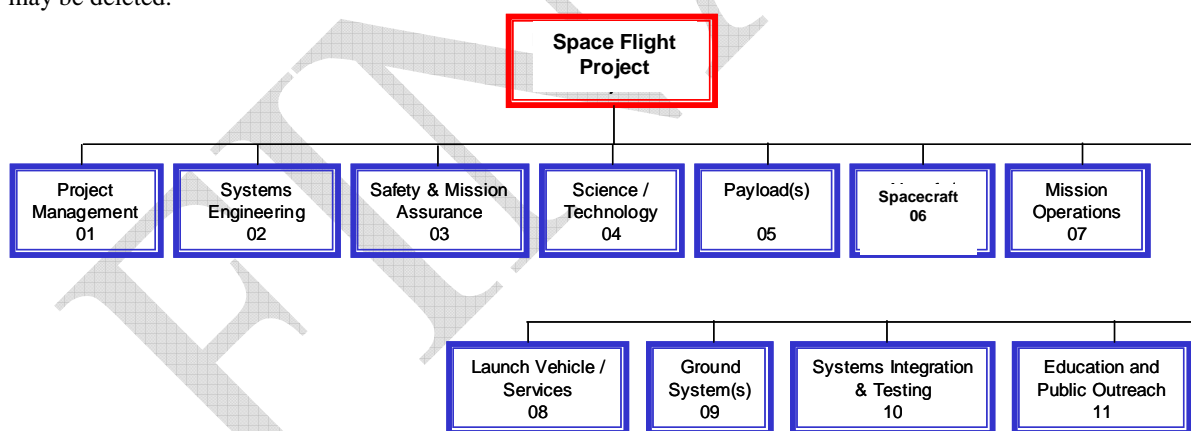


Figure G.4-1 Standard Level 2 WBS Elements for Space Flight Projects

Space Flight Project Standard WBS Dictionary

Element 1 – Project Management: The business and administrative planning, organizing, directing, coordinating, controlling, and approval processes used to accomplish overall Project objectives, which are not associated with specific hardware or software elements. This element includes project reviews and documentation, non-project owned facilities, and project reserves. It excludes costs associated with technical planning and management, and costs associated with delivering specific engineering, hardware and software products.

Element 2 – Systems Engineering: *[Include in 7.0, Mission Operations.]* The technical and management efforts of directing and controlling an integrated engineering effort for the project. This element includes the

efforts to define the project space flight vehicle(s) and ground system, conducting trade studies; the integrated planning and control of the technical program efforts of design engineering, software engineering, specialty engineering, system architecture development, and integrated test planning, system requirements writing, configuration control, technical oversight, control and monitoring of the technical program, and risk management activities. Documentation products include requirements documents, interface control documents (ICDs), Risk Management Plan, and master verification and validation (V&V) plan. Excludes any design engineering costs.

Element 3 – Safety and Mission Assurance: *[Include in 7.0, Mission Operations.]* The technical and management efforts of directing and controlling the safety and mission assurance elements of the project. This element includes design, development, review, and verification of practices and procedures and mission success criteria intended to assure that the delivered spacecraft, ground systems, mission operations, and payload(s) meet performance requirements and function for their intended lifetimes. This element excludes mission and product assurance efforts at partners/ subcontractors other than a review/oversight function, and the direct costs of environmental testing.

Element 4 – Science / Technology: This element includes the managing, directing, and controlling of the science investigation aspects, as well as leading, managing, and performing the technology demonstration elements of the Project. The costs incurred to cover the Principal Investigator, Project Scientist, science team members, and equivalent personnel for technology demonstrations are included. Specific responsibilities include defining the science or demonstration requirements; ensuring the integration of these requirements with the payloads, spacecraft, ground systems, mission operations; providing the algorithms for data processing and analyses; and performing data analysis and archiving. This element excludes hardware and software for on-board science investigative instruments / payloads.

Element 5 – Payload: *[Include in 4.0, Science.]* This element includes the equipment provided for special purposes in addition to the normal equipment (i.e., GSE) integral to the spacecraft. This includes leading, managing, and implementing the hardware and software payloads that perform the scientific experimental and data gathering functions placed on board the spacecraft, as well as the technology demonstration for the mission.

Element 6 – Spacecraft(s): *[Include in 7.0, Mission Operations.]* The spacecraft that serves as the platform for carrying payload(s), instrument(s), humans, and other mission-oriented equipment in space to the mission destination(s) to achieve the mission objectives. The spacecraft may be a single spacecraft or multiple spacecraft/modules (i.e., cruise stage, orbiter, lander, or rover modules). Each spacecraft/module of the system includes the following subsystems as appropriate: Crew, Power, Command & Data Handling, Telecommunications, Mechanical, Thermal, Propulsion, Guidance Navigation and Control, Wiring Harness, and Flight Software. This element also includes all design, development, production, assembly, test efforts and associated GSE to deliver the completed system for integration with the launch vehicle and payload. This element does not include integration and test with payloads and other project systems.

Element 7 - Mission Operations System: The management of the development and implementation of personnel, procedures, documentation and training required to conduct mission operations. This element includes tracking, commanding, receiving/processing telemetry, analyses of system status, trajectory analysis, orbit determination, maneuver analysis, target body orbit/ephemeris updates, and disposal of remaining mission resources at end-of-mission. The same WBS structure is used for Phase E Mission Operation Systems but with inactive elements defined as “not applicable.” However, different accounts must be used for Phase E due to NASA cost reporting requirements. This element does not include integration and test with the other project systems.

Element 8 – Launch Vehicle / Services: *[Not applicable for operating missions.]* The management and implementation of activities required to place the spacecraft directly into its operational environment, or on a trajectory towards its intended target. This element includes launch vehicle; launch vehicle integration; launch operations; any other associated launch services (frequently includes an upper-stage propulsion system), and associated ground support equipment. This element does not include the integration and test with the other project systems.

Element 9 – Ground System(s): The complex of equipment, hardware, software, networks, and mission-unique facilities required to conduct mission operations of the spacecraft systems and payloads. This complex includes the computers, communications, operating systems, and networking equipment needed to interconnect and host the Mission Operations software. This element includes the design, development, implementation, integration, test and the associated support equipment of the ground system, including the hardware and software needed for processing, archiving and distributing telemetry and radiometric data and for commanding the spacecraft. Also includes the use and maintenance of the project testbeds and project-owned facilities. This element does not include integration and test with the other project systems and conducting mission operations.

Element 10 – Systems Integration and Testing: *[Not applicable for operating missions, or include in 7.0 Mission Operations.]* This element includes the hardware, software, procedures and project-owned facilities required to perform the integration and testing of the project's systems, payloads, spacecraft, launch vehicle / services, and mission operations.

Element 11 – Education and Public Outreach: Provide for the education and public outreach (EPO) responsibilities of NASA's missions, projects, and programs in alignment with the Strategic plan for Education. Includes management and coordinated activities, formal education, informal education, public outreach, media support, and web site development.

Additional work element definitions:

"Data Analysis" encompasses the work scope defined in Element 4 above, and specific project-funded data processing of Level 1 and above products. Activities typically included in "Data Analysis" are: customized data processing, analysis activities, documentation, presentation and publication of scientific results, science events planning, instrument and observation performance analysis, science data calibration, validation and certification of processed data, science operations centers, etc. If there are essential data analysis tasks and products currently funded by ROSES elements, the mission team may consider including these activities in the 'optimal' mission proposal.

"Mission Operations" encompasses the work scope defined in Element 7 above, data acquisition and processing through Level 0 only. Activities typically included in "Mission Operations" are: command generation and telemetry monitoring; health and performance monitoring of the spacecraft, instruments, and ground system; mission analysis and planning/scheduling; spacecraft resource (power, etc) constraints analysis; trajectory, orbit, attitude planning and determination, etc.

"Competed Science" encompasses investigations solicited through ROSES.

Attachment B:
MS Excel spreadsheet: ESD Senior Review FY10-FY13_Std_Spreadsheet.xls

Project Name:						
Point of Contact:						
Table						
I	FY09 - FY13 In-Guideline Scenario Budget by Operating Organization					
		FY09	FY10	FY11	FY12	FY13
	Center: [e.g. GSFC, JPL, U of Texas, ...]					
	Include all applicable Centers/Organizations					
	1000 Labor					
	2100 Travel					
	3000 Procurements					
	8020 Contracted Services					
	Total*	0.0	0.0	0.0	0.0	0.0
II	FY09 - FY13 In-Guideline Scenario Budget by WBS					
		FY09	FY10	FY11	FY12	FY13
	1.0 Project Management					
	4.0 Science					
	7.0 Mission operations					
	9.0 Ground systems					
	11.0 Education & Public Outreach					
	Total*	0.0	0.0	0.0	0.0	0.0
* Totals for Table II should be equal to the year by year totals in Table I.						
III	FY09 - FY13 In-Guideline Scenario Budget by Instrument Team					
		FY09	FY10	FY11	FY12	FY13
	1. Instrument A					
	2. Instrument B					
	3. Instrument C					
	4. etc., (Repeat for all instrument teams)					
	Other science teams					
	Other mission expenses					
	Total*	0.0	0.0	0.0	0.0	0.0
* Totals for Table III should be equal to the year by year totals in Table I.						
IV	FY09 - FY13 In-Guideline Scenario - In Kind Support					
		FY09	FY10	FY11	FY12	FY13
	1.0 Project Management					
	4.0 Science					
	7.0 Mission operations					
	9.0 Ground systems					
	11.0 Education & Public Outreach					
	Total	0.0	0.0	0.0	0.0	0.0
Table						
V	FY09 - FY13 Optimal Mission Budget by Operating Organization					
		FY09	FY10	FY11	FY12	FY13
	Center: [e.g. GSFC, JPL, U of Texas, ...]					
	Include all applicable Centers/Organizations					
	1000 Labor					
	2100 Travel					
	3000 Procurements					
	8020 Contracted Services					
	Total**	0.0	0.0	0.0	0.0	0.0
VI	FY09 - FY13 Optimal Mission Budget by WBS					
		FY09	FY10	FY11	FY12	FY13
	1.0 Project Management					
	4.0 Science					
	7.0 Mission operations					
	9.0 Ground systems					
	11.0 Education & Public Outreach					
	Total**	0.0	0.0	0.0	0.0	0.0
** Totals for Table VI should be equal to the year by year totals in Table V.						
VII	FY09 - FY13 Optimal Mission Budget by Instrument Team					
		FY09	FY10	FY11	FY12	FY13
	1. Instrument A					
	2. Instrument B					
	3. Instrument C					
	4. etc., (Repeat for all instrument teams)					
	Other science teams					
	Other mission expenses					
	Total**	0.0	0.0	0.0	0.0	0.0
** Totals for Table VII should be equal to the year by year totals in Table V.						
VIII	FY09 - FY13 Optimal Mission - In Kind Support					
		FY09	FY10	FY11	FY12	FY13
	1.0 Project Management					
	4.0 Science					
	7.0 Mission operations					
	9.0 Ground systems					
	11.0 Education & Public Outreach					
	Total	0.0	0.0	0.0	0.0	0.0

Project Name:						
Point of Contact:						
All entries in Full Time Equivalent (FTE) personnel for Civil Servants, or Work Year Equivalents (WYE) for Contractors						
Table						
I	FY09 - FY13 In-Guideline Scenario Budget by Operating Organization					
		FY09	FY10	FY11	FY12	FY13
	Center: [e.g. GSFC, JPL, U of Texas, ...]					
	Include all applicable Centers/Organizations					
	Civil Service FTEs (9051)					
	On-Site Contractor WYEs (9052)					
	Service Pool FTEs (8021)					
	Total*	0.0	0.0	0.0	0.0	0.0
II	FY09 - FY13 In-Guideline Scenario Total Budget Request					
		FY09	FY10	FY11	FY12	FY13
	1.0 Project Management					
	4.0 Science					
	7.0 Mission operations					
	9.0 Ground systems					
	11.0 Education & Public Outreach					
	Total*	0.0	0.0	0.0	0.0	0.0
* Totals for Table II should be equal to the year by year totals in Table I.						
III	FY09 - FY13 In-Guideline Scenario Budget by Instrument Team					
		FY09	FY10	FY11	FY12	FY13
	1. Instrument A					
	2. Instrument B					
	3. Instrument C					
	4. etc., (Repeat for all instrument teams)					
	Other science teams					
	Other mission expenses					
	Total*	0.0	0.0	0.0	0.0	0.0
* Totals for Table III should be equal to the year by year totals in Table I.						
IV	FY09 - FY13 In-Guideline Scenario - In Kind Support					
Table						
V	FY09 - FY13 Optimal Mission Budget by Operating Organization					
		FY09	FY10	FY11	FY12	FY13
	Center: [e.g. GSFC, JPL, U of Texas, ...]					
	Include all applicable Centers/Organizations					
	Civil Service FTEs (9051)					
	On-Site Contractor WYEs (9052)					
	Service Pool FTEs (8021)					
	Total**	0.0	0.0	0.0	0.0	0.0
VI	FY09 - FY13 Optimal Mission Total Budget Request					
		FY09	FY10	FY11	FY12	FY13
	1.0 Project Management					
	4.0 Science					
	7.0 Mission operations					
	9.0 Ground systems					
	11.0 Education & Public Outreach					
	Total**	0.0	0.0	0.0	0.0	0.0
** Totals for Table VI should be equal to the summation of entries in all Tables V.						
VII	FY09 - FY13 Optimal Mission Budget by Instrument Team					
		FY09	FY10	FY11	FY12	FY13
	1. Instrument A					
	2. Instrument B					
	3. Instrument C					
	4. etc., (Repeat for all instrument teams)					
	Other science teams					
	Other mission expenses					
	Total**	0.0	0.0	0.0	0.0	0.0
** Totals for Table VII should be equal to the year by year totals in Table V.						
VIII	FY07 - FY11 Optimal Mission - In Kind Support					
	N/A					

General Guidelines	
Show all costs in Real-Year dollars. Where appropriate, the inflation factor for each successive year is 2.4%	
For FY09 repeat of the full cost budget as it currently exists in the NASA budget data base.	
For those missions with budgeted activities at more than one NASA center provide the full cost budget for <u>each center</u> , split out by the three lines shown (labor, travel and procurements). Then provide the total mission costs broken out by WBS element	
If the primary mission ends in the middle of a fiscal year show only the portion of the year that is in the extended mission phase, and indicate the start date for the extended mission.	
All key assumptions for the mission extension should be identified including dependencies on other projects, initiatives or facilities outside Project funding. If assumptions for the in-guideline and requested/optimal scenarios differ, please note in the appropriate tab.	
Table	
I	FY09 - FY13 In-Guideline Scenario Budget by Operating Organization
	Separate entries should be made for each supporting Center or Institution.
II	FY09 - FY13 In-Guideline Scenario Total Budget Request
	Describe how your project's budget breaks down by function, for FY09 through FY13.
	The rows in Tables II correspond to the WBS definitions shown in Attachment A to the Call for Proposals.
	The total of all the functional elements should equal the project total represented in Table I.
	Separate entries should be made for each supporting Center or Institution.
III	FY09 - FY13 In-Guideline Scenario Budget by Instrument Team
	Describe how your budget breaks down by the instrument teams.
	If you are a single instrument mission, leave this table blank.
	"Other Science teams" may apply to cross instrument science teams and efforts.
	"Other expenses" may apply to shared services such as mission operations, E/PO, Cal/Val, etc..
IV	FY09 - FY13 In-Guideline Scenario - In Kind Support
	The rows follow the WBS definitions of Attachment A.
	In kind support should be the sum of all contributions. The most significant contributions may be called out individually, but need not be.
V	FY09 - FY13 Optimal Mission Budget by Operating Organization
	Separate entries should be made for each supporting Center or Institution.
VI	FY09 - FY13 Optimal Mission Total Budget Request
	The rows follow the WBS definitions of Attachment A.
VII	FY09 - FY13 Optimal Mission Budget by Instrument Team
	Same as for Table III
VIII	FY09 - FY13 Optimal Mission - In Kind Support
	The rows follow the WBS definitions of Attachment A.
	In kind support should be the sum of all contributions. The most significant contributions may be called out individually, but need not be.

Attachment C: Efficiency Measures

In response to OMB requirements, NASA is establishing efficiency metrics to cover a larger proportion of its budgeted activities. Efforts to identify an appropriate metric for missions in extended operations have led us to the conclusion that different metrics should be applied to different types of missions, depending on such factors as age, type of instrumentation/observations, and types of products produced. SMD's approach is to create an 'umbrella metric' which simply states that a certain percentage (TBD) of SMD operating missions, likely weighted by budget, will meet their individual efficiency metrics for the year in question. Individual missions must propose at least one efficiency metric, either from the pre-approved list below or a more appropriate metric proposed by the mission. If the alternate metric is accepted by OMB, only the alternate will be used for reporting.

An acceptable efficiency metric does not measure effectiveness, but rather measures productivity, and must be reducible eventually to a form of decreasing unit cost for some deliverable. For example, increasing the number of routine data products through added quick-look or Near-Real-Time products or transitioning a research product to a core product, without requesting additional funding, is an acceptable efficiency measure in that an explicit number of products can be counted and measured against the cost spent by the Mission Operations and Science Teams to acquire, process and deliver a validated product to the data center. On the other hand, an increasing number of publications is considered by OMB as a measure of the effectiveness of our missions, but does not represent a higher productivity within the Mission Operations or Science Teams.

Suggested, pre-approved efficiency measures:

1. Increase the number of core data products routinely provided to the user community, with constant (inflation-adjusted) funding.
2. Continue to provide established core data products (or equivalent) with decreased or flat funding.
3. Decrease unit cost of data acquisition and processing to Level 0.

Each proposed efficiency measure must be defined as an explicit quantity that is traceable to current performance in FY09, with targets in future years that show quantifiable improvement as either increasing deliverables or decreasing unit costs.

Example Metrics:

Example 1. Increase number of core data products routinely provided to the user community, with constant (inflation-adjusted) funding.

FY09 Baseline		FY10 Target		FY11 Target		FY12 Target		FY13 Target	
#Products	Budget (\$M)	#Products	Budget (\$M)	#Products	Budget (\$M)	#Products	Budget (\$M)	#Products	Budget (\$M)
10	\$7.5	11	\$7.7	12	\$8.0	13	\$8.2	14	\$8.5

This sample metric implies that the cost per product decreases from \$750K to \$610K.

Example 2: Cost per Gigabyte of data delivered by Earth science satellites

Description: NASA has several satellites orbiting the Earth to make frequent global observations. These satellites were launched during the period 1997 through 2004, and have instruments on board that provide measurements of many properties of the land, oceans and atmospheres. These measurements are transmitted to remote ground stations and received at NASA's Goddard Space Flight Center. A system called the Earth Observing System Data and Operations System (EDOS) at Goddard is used for capturing these data and preparing them for use by scientific teams and operational agencies typically within 3 hours of receiving at the ground stations. NASA has been making improvements to this system over the last two years. This metric reflects the efficiency of operating and managing the data from satellites. It is calculated by dividing the operations budget of EDOS by the number of gigabytes (billions of bytes) delivered.

Baseline (FY 08): \$39/GB

Targets: FY 09: \$38/GB; FY 10: \$22/GB;

Assumptions: All of NASA's Earth observing satellites and instruments continue to operate in good condition.